DOCUMENT RESUME

ED 160 885 CE 018 360

TITLE Related Instructional Material for Electrical Apprentice Technical Training. Student Worksheets. Series D (Fourth Year). Revised to Meet 1978 Electrical Code.

INSTITUTION North Carolina State Dept. of Community Colleges, Raleigh.

PUB DATE 78

NOTE 60p.; Not available in hard copy due to faint print in original document; For related documents see CE 018 350-359

EDRS PRICE MF-$0.83 Plus Postage. HC Not Available from EDRS.

DESCRIPTORS *Apprenticeships; *Electrical Occupations; Electrical Systems; Electric Circuits; Electronics; Learning Activities; Postsecondary Education; Technical Education; Trade and Industrial Education; *Worksheets

ABSTRACT

Information sheets and student worksheets for twenty-seven lesson plans designed for a fourth-year electrical apprentice technical training program are presented in this workbook. The information sheets provide summary information about the lesson topics and the worksheets contain problems to be solved and questions to be answered relating to each lesson. Some of the lesson topics are cable trays, cellular metal floor raceways, switchboards and panelboards, radio and television equipment, troubleshooting control circuits, basic theory of electronics, and effective foremanship. (The instructor's manual containing lesson plans and unit tests is available as document CE 018 359. Other related documents are CE 018 350-360.) (JH)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED160885

STUDENT WORKSHEETS

RELATED INSTRUCTIONAL MATERIAL

FOR

ELECTRICAL APPRENTICE

TECHNICAL TRAINING

SERIES D

(fourth Year)

Revised to meet 1978 Electrical Code

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

Roger G. Worthington

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC) AND THE ERIC SYSTEM CONTRACTORS."

PROGRAM DEVELOPMENT
DEPARTMENT OF COMMUNITY COLLEGES
RALEIGH, NORTH CAROLINA

CE 018 360

FOREWORD

The apprenticeship programs offered in North Carolina are important phases of the total educational program for industry in the state. The program of education for modern apprenticeship includes two distinct phases. The first phase is "on-the-job training." The student is employed by a firm in which duties are specifically assigned to enhance ones learning in the field of study. These experiences are planned and supervised so that the individuals will progress through the apprenticeship phase to that of the journeyman. The second phase of the program of education is termed "related instruction." In this phase the apprentice is provided the technical and theoretical foundation subjects that help one to learn the trade thoroughly and accurately. This portion is usually taught through evening school, but in some cases may be done through correspondence courses.

The North Carolina Department of Community Colleges, through the Program Development Section, has the responsibility for developing and making available the instructional materials that provide the learner with a sound educational program which is effective and appropriate to the method in which the materials are being utilized. The department has available these materials for the students, as well as support material for the instructor who teaches or who acts as counselor in conducting the related classes.

Roger G. Worthington

Roger G. Worthington, Director
Program Development

Ben E. Fountain, Jr.

Ben E. Fountain, Jr., State President
Department of Community Colleges

PREFACE

The Program Development Section of the Department of Community Colleges has the responsibility for making available the related instructional materials required for use in occupational programs offered by the various institutions. This responsibility is accomplished by working with advisory committees and consultants representing each of the occupations in determining the needs and in developing the materials required to meet these needs.

These information sheets and worksheets have been prepared to provide specific assignments for studying related topics necessary in the training of electrical apprentices. An effort was made to develop the schedule to follow as the apprentice progresses with training. It will also enable the apprentice to know what skills and knowledges will be required. The objective of this program is to aid the instructor and employer in providing experiences necessary to develop not only a competent worker in the electrical field, but also, a well-rounded citizen.

This workbook includes assignment sheets and information sheets for the electrical apprentice to use in searching out related information. The worksheets contain problems to solve, questions to answer diagrams to draw, and blueprints to consult. The apprentice should study the references (assigned by the instructor) before attempting to answer the questions or solve the problems.

In actual use of these lessons, instructors should feel free to modify their application of the material to conform with local needs. For example, there may be certain sections of the Code to teach because the apprentices are working with special installations. Thus, the instructor should lead a discussion on materials that applies to these situations. In other classes, the instructor may need to spend more time with the students on topics dealing with mathematics than with blueprint reading. In any event, the minimum class time for related material is 144 hours per year. It is sincerely hoped that the assignment sheets are used correctly so that apprentices can gain maximum benefits from their related studies.

ELECTRICAL APPRENTICESHIP TECHNICAL TRAINING

ACKNOWLEDGMENTS

Questions and problems for the Lesson Topics were prepared in July, 1964 by:

W.F. Humbert, III, Electrical Engineer
Winston-Salem, North Carolina

The Instructor's Manuals, Information and Orientation Sheets were developed by:

Howard E. Hedinger, Educational Consultant
Department of Community Colleges
Raleigh, North Carolina

The manual was revised in 1967, 1971, and 1975.

REVISION COMMITTEE 1978

Mr. Jack McKeel, Chairman - Instructor, Jamestown, North Carolina
Mr. F. Lloyd Willard, Electrical Inspector High Point, North Carolina
Dr. Larry W. Fuqua, Assistant Director for Vocational & Apprenticeship Programs, Department of Community Colleges, Program Development
Raleigh, North Carolina

CONTENTS

LESSON	LESSON TOPICS	PAGE	ASSIGNMENT DATE
D-1	Cable Trays	1	_____
D-2	Nonmetallic Extensions	3	_____
D-3	Underplaster Extension	5	_____
D-4	Surface Metal Raceways	7	_____
D-5	Multioutlet Assembly	9	_____
D-6	Underfloor Raceways	11	_____
D-7	Cellular Metal Floor Raceways	13	_____
D-8	Cellular Concrete Floor Raceways	15	_____
D-9	Busways	17	_____
D-10	Cablebus	19	_____
D-11	Switches	21	_____
D-12	Switchboards and Panelboards	23	_____
D-13	High Voltage Equipment and Installation	25	_____
D-14	Theaters and Assembly Halls	27	_____
D-15	Communication Circuits	29	_____
D-16	Radio and T. V. Equipment	31	_____
D-17	Data Processing Equipment	33	_____
D-18	Low Voltage Systems	35	_____
D-19	Analysis of Control Circuits	37	_____
D-20	Maintaining Control Equipment	39	_____
D-21	Troubleshooting Control Circuits	41	_____
D-22	Principles of Static Control	43	_____
D-23	Transistors as Logic Elements	45	_____
D-24	Basic Theory of Electronics	47	_____
D-25	Welders, Resistors, and Rectifiers	53	_____
D-26	Job Management	55	_____
D-27	Effective Foremanship	59	_____

NAME _____ LESSON D-1

DATE _____ WORKSHEET

CABLE TRAYS

REFERENCE: National Electrical Code - Article 318

1. Trays shall have side rails or equivalent structural members.
   True/False _____ Code Reference _____

2. Cable Trays shall be installed as a complete _____ system.

3. Each run of cable trays shall be complete before the _____ _____ of cables.

4. The minimum vertical clearance between tiers shall be _____ inches.

5. All parts of the cable trays shall be bonded together and _____.

6. List three types of cables that may be used in cable trays.

   (a) _____
   (b) _____
   (c) _____

7. A cable tray system may be used as a grounded circuit. conductor. True/False _____ Code Reference _____.

8. Where 600 volt and 5 kv cables are installed in the same cable tray, solid _____ - _____ partitions shall be provided to _____ the types of _____.

9. Trays shall not extend through _____ walls.

10. Trays may be used for exposed work in _____ or _____ _____ locations.

11. List three areas approved for using cable trays:

    (a) _____
    (b) _____
    (c) _____

12. List three areas not approved for using cable trays:

    (a) _____
    (b) _____
    (c) _____

13. Are single conductor cables allowed to be installed in cable trays? _____ Code Reference _____

14. If the answer to question # 13 is yes, give the minimum size conductor permitted. _____.

15. The minimum horizontal distance between cable trays shall be _____

16. Trays shall be _____ and _____ connected to the enclosure in which cables terminate.

NAME _____ LESSON D-2

DATE _____ WORKSHEET

NONMETALLIC EXTENSIONS

REFERENCE: National Electrical Code - Article 342.

1. Nonmetallic extensions shall be made from a _____ or _____ ampere branch circuit.

2. Nonmetallic extensions shall be mounted a minimum of two inches above the _____.

3. Nonmetallic extensions may be installed in a residence or _____.

4. An extension shall be attached only to woodwork or _____.

5. Nonmetallic extensions may be installed in an unfinished basement. True/False _____ Code Reference _____

6. Nonmetallic extensions shall not be installed where subject to _____ vapors.

7. Each run of nonmetallic extensions shall terminate in a fitting which covers the _____ of the assembly.

8. Nonmetallic extensions may be run exposed in a _____ location.

9. Nonmetallic extensions may extend outside the room in which it originates. True/False _____ Code Reference _____

10. Fastenings shall be located a _____ of eight inches on centers.

11. Splices and _____ shall not be made in nonmetallic extensions except in approved fittings.

12. Receptacle type tap connector shall be of the _____ type.

13. Fastenings shall be located a maximum of _____ inches on centers.

14. The end of the extension shall terminate in a _____.

NAME _____ LESSON D-3

DATE _____ WORKSHEET

UNDERPLASTER EXTENSIONS

REFERENCE: National Electrical Code - Article 344.

1. An underplaster extension may be used only for extending an existing _____ circuit.

2. An underplaster extension may be installed in a _____ - _____ constructed building only.

3. NM cable may be used for underplaster extension. True/False _____
   Code Reference _____

4. List five types of raceways approved for underplaster extensions:

   (a) _____
   (b) _____
   (c) _____
   (d) _____
   (e) _____

5. Underplaster extensions shall not extend beyond the _____ where it originates unless it is installed in _____ metal _____, _____ metal clad cable, or ____ ____ cable.

6. Underplaster extensions shall be mounted on the face of _____ walls.

7. Underplaster extensions shall be buried in _____ finish of ceiling or _____.

NAME _____ LESSON D-4

DATE _____ WORKSHEET

SURFACE METAL RACEWAYS

REFERENCE: National Electrical Code - Article 352.

1. Installations of surface metal raceway shall comply with the applicable provisions of Article _____.

2. The conductors, including splices and taps, shall not fill the raceway to more than _____ percent of its area at that point.

3. All splices and taps shall be made by _____ methods.

4. Multi-outlet assemblies may be extended through dry walls.
   True/False _____ Code Reference _____

5. The maximum voltage normally permitted in a surface metal raceway is _____ volts. Can it be higher? Code Reference _____

6. No conductor _____ than that for which the raceway is designed shall be installed in surface metal raceway.

7. Surface metal raceway may be installed in hazardous locations.
   True/False _____ Code Reference _____

8. Surface metal raceway shall be installed in _____ locations only.

9. Surface metal raceways may extend through _____ and _____.

10. Raceway shall be _____ from outlet to outlet.

11. Name the tool used to cut surface metal raceways. _____

12. The minimum support for surface metal raceway is _____ feet.

13. In general surface metal raceway is _____ feet long.

14. Combination raceways shall have _____ compartments for signal, lighting, and power circuits.

15. Screw or bolt-heads shall be installed _____ with the interior surface of the raceway they support.

16. Are non metallic surface raceways permitted? _____
    Code Reference _____.

NAME _____ LESSON D-5

DATE _____ WORKSHEET

MULTIOUTLET ASSEMBLY

REFERENCE: National Electrical Code - Article 353.

1. Metal multioutlet assembly may be extended through _____ partitions.

2. Assembly may be installed in _____ location(s).
(a) dry (b) wet (c) both

3. Nonmetallic multioutlet assembly may be recessed in the _____.
(a) baseboard (b) ceiling (c) both

4. What type of assembly may be installed where subject to severe physical damage? _____

5. Assembly may be installed in any hazardous location. True/False _____ Code Reference _____

6. Assembly is a raceway designed to hold _____ and _____.

7. Assembly may be _____ or _____ assembled.

8. Assembly shall not be installed in hazardous locations such as _____ vapors or in _____.

9. Assembly may be installed from _____ to _____ provided the partitions are dry and contain no outlets.

10. Receptacles in a multioutlet assembly shall be _____-wire, _____ type.

NAME _____ LESSON D-6

DATE _____ WORKSHEET

UNDERFLOOR RACEWAYS

REFERENCE: National Electrical Code - Article 354.

1. Underfloor raceway shall not be installed where subject to _____ vapors.

2. Dead ends of raceways shall be _____.
(a) closed (b) left open for future use

3. The combined cross-sectional area of all conductors shall not exceed _____ percent of the interior area of the raceway except that when raceway contains only type AC or NM sheathed cable.
(a) 40 (b) 50 (c) 60

4. Junction boxes used with metal raceways shall be _____.
(a) metal (b) plastic (c) wood

5. Inserts set in fiber raceways after the floor is laid shall be _____ into the raceway.

6. Raceways spaced less than one inch apart shall be covered with concrete to a depth of _____ inches.

7. Approved flush raceways with removable covers may be laid _____ with the floor surface.

8. No conductor larger than that for which the raceway is _____ shall be installed in underfloor raceways.

9. Markers shall extend through the finish of the _____.

10. Installations of underfloor raceways shall comply with the applicable provisions of Article _____.

11. Splices and taps shall be made only in _____ _____.

12. Conductors supplying a discontinued outlet shall be removed from the _____ _____.

13. Where raceways are run at other than right angles, _____ _____ shall be provided.

14. Describe 'Loop Wiring". _____
_____

14. A marker fitting shall be installed at the end of every line of the _____.

15. Underfloor raceways in office buildings may be used for low voltage _____, _____ and _____ systems.

16. The maximum voltage permitted in a raceway is _____ volts.

17. All joints in raceway shall be _____.

18. Metal raceways shall be properly _____.

19. Wires for _____ or _____ systems shall not be run in the same duct with convenience outlet wires.

20. In junction boxes, separate _____ shall be provided for each system.

21. No _____ or taps shall be made at outlet inserts.

NAME _____ LESSON D-7

DATE _____ WORKSHEET

CELLULAR METAL FLOOR RACEWAYS

REFERENCE: National Electrical Code - Article 356.

1. No conductor larger than # _____ shall be installed in any cell or header except by special permission.
2. Inserts shall be _____ with the floor grade.
3. Inserts shall be _____ against the entrance of water.
4. Inserts shall be made of _____ mater .
5. Inserts shall be _____ continuous with the raceway.
6. Splices and taps shall be made only in header access units or _____ _____.
7. Conductors feeding a discontinued outlet shall be _____ from the raceway.
8. Markers shall be installed throughout the system for future _____ of electrical cells.
9. In commercial garages, conductors may be installed in raceways feeding ceiling outlets or extensions to _____ _____ the _____.
10. So called loop wiring is not considered to be a splice or tap in cellular metal floor raceway. True/False _____ Code Reference _____
11. A "header" duct is a transverse raceway for electrical conductors. True/False _____ Code Reference _____
12. Header provides access to predetermined _____ of a cellular metal floor.
13. Header permits the installation of electrical _____ from a distribution center to the cells.
14. Core _____ are used to cut hole in center of cell.
15. In general, the cells of a cellular metal floor are on _____ inch centers.

NAME _____ LESSON D-8

DATE _____ WORKSHEET

CELLULAR CONCRETE FLOOR RACEWAYS

REFERENCE: National Electrical Code - Article 358.

1. No conductor larger than # _____ shall be installed, excert by special permission

2. Splices and taps shall be made only in header access units or _____ _____.

3. Conductors supplying _____ outlets shall be removed.

4. Connections to cabinets and extensions from ce ls to outlets shall be made by means of _____ or _____ conduit or approved fittings.

5. Inserts shall be _____ with the floor.

6. Inserts shall be _____ against the entrance of water.

7. Conductors shall not be installed in a raceway in _____ or _____ locations.

8. Conductors shall not be installed in raceway to supply outlets in the area above the _____ of a commercial garage.

9. Headers are installed perpendicular to the _____ of the cells.

10. Headers is a metal raceway providing access to predetermined _____ in the slab.

11. Installations of conductors in the raceway of cellular metal floor shall comply with the applicable provisions of Article _____.

12. Header duct end joints shall be closed by _____ closure fittings.

13. Header duct shall be _____ continuous through the system and shall be _____ bonded to the enclosure of the _____ _____.

14. Connections between cabinet and header shall be made by means of _____ _____ and _____ _____.

15. Receptacles shall be of the _____ type.

16. A _____ conductor shall connect the receptacle to a positive ground connection on the _____ duct.

17. Cellular concrete floors are constructed of _____ _____ concrete members.

NAME _____ LESSON D-9

DATE _____ WORKSHEET

BUSWAYS

REFERENCE: National Electrical Code - Article 364.

1. Busways shall be installed only for exposed work? True/False.

2. Busways may be installed as service _____ conductors.

3. Approved busways may be installed outdoors or in _____ or _____ locations.

4. List three areas in which busways are prohibited:

   (a) _____
   (b) _____
   (c) _____

5. Ground _____ and _____ plug should be installed on busways of ungrounded secondary systems.

6. Normal supports for a busway shall not exceed _____ feet.

7. Unbroken lengths (no joints) of busways may _____ through walls.

8. Busway dead ends shall be _____.

9. Busways may extend through floors provided a totally _____ busway is installed up to a minimum of _____ feet above the floor for physical _____.

10. Branch circuits from busways shall be provided with _____ - in devices.

11. Busway taps, having a minimum rating of _____ the ampere capacity of main duct protective devices and a maximum length of _____ feet, are not required to have _____ protective devices.

12. Rating of the overcurrent _____ device determines the ampere rating of the busway branch circuit.

13. The three major types of busways are:

   (a) _____
   (b) _____
   (c) _____

14. Plug-in bus duct overcurrent protective devices are either:

(a) _____
(b) _____

15. Light duty lighting duct and trolley duct have "take-off" devices which are fused or non - _____ or have a _____ breaker protective device.

16. One-bolt construction of modern bus duct systems require _____ wrenches to assure proper joint connection.

17. Busways are normally hung by what three methods?

(a) _____
(b) _____
(c) _____

ALTERNATE ANSWER: (d) _____

18. Bus duct of over 600 volts shall be identified by what 7 items of information on the nameplate?

a. _____
b. _____
c. _____
d. _____
e. _____
f. _____
g. _____

NAME _____ LESSON D-10

DATE _____ WORKSHEET

CABLEBUS

REFERENCE: National Electrical Code - Article 365.

1. Cablebus is an approved assembly of _____ conductors mounted in _____ relationship in a ventilated _____ protective _____ structure.

2. The minimum wire size for cablebus conductors is _____ AWG.

3. The conductor insulation for cablebus conductors is _____°C. The code designation for the insulation is _____.

4. The ampacity of the cablebus conductor is based on single conductors in _____ _____, as found in tables _____ and _____ of the N. E. Code.

5. Cablebus voltage ratings are from zero volts to _____ volts.

6. The supporting structure of cablebus can be used on an equipment _____ conductor when adequately bonded.

7. The controlled spacing of cablebus conductors provides low _____ and low _____ drop.

8. Cablebus may be installed _____ ___ or _____ in either _____ or _____ locations.

9. The five major steps in installing cablebus are:

   (a) _____
   (b) _____
   (c) _____
   (d) _____
   (e) _____

10. Conductor supports in cablebus are _____ feet for horizontal runs and _____ feet for vertical runs.

11. Maximum spacing of hangers for the support system shall not exceed _____ feet.

12. Approved _____ means shall be used for connections to cablebus conductors.

13. Special fittings are required for the cablebus system:

(a) _____
(b) _____
(c) _____

14. Vertical and horizontal spacing between conductors is not less than one _____ _____ at the point of support.

NAME _____ LESSON D-11

DATE _____ WORKSHEET

SWITCHES

1. Switches shall not disconnect the _____ _____ of a circuit.

2. All switching shall be done in the _____ conductor.

3. In conduit installations, all _____ between switch and outlet shall be in the same raceway.

4. Switches shall be mounted in _____ _____ and shall be _____ operated.

5. Switches mounted outdoors shall be in _____ enclosures.

6. Time switches shall be enclosed in _____ _____.

7. Double-_____ knife switch may be mounted vertically or horizontally.

8. Single-throw knife switch shall be connected so that blades are _____ or _____ when the switch is open.

9. Face plates for flush mounted snap switches mounted within reach of conducting surfaces shall be made of _____ material.

10. Voltage between ganged snap switches cannot exceed _____ volts unless permanently installed _____ are installed between adjacent switches.

11. Switch boxes for circuits of over 150 volts to ground shall be _____.

12. Circuit breakers or switches of special design shall be installed to _____ circuits greater than 1200 amperes at 250 volts or less.

13. Isolating switches are installed to _____ the circuit from the _____ and are intended to be operated only after the circuit has been _____.

14. A fused switch shall be wired so that the fuses will be _____ when the switch is open.

15. A switch is not designed for interruption of a circuit under _____-_____ conditions.

16. A _____ - _____ switch breaks the connection in two conductors of a circuit.

17. A _____ - _____ switch will make a closed circuit when thrown in either of two positions.

18. Oil switches have contact parts _____ in the liquid.

19. What two items of information appear on all switches?

    a. _____

    b. _____

20. Fused switches cannot have fuses in parallel. True / False _____
    Code Reference _____.

NAME _____ LESSON D-12

DATE _____ WORKSHEET

SWITCHBOARDS AND PANELBOARDS

1. _____ shall be accessible only from the front.
2. Panelboards shall be mounted in or _____ a wall or _____.
3. Switchboards are generally accessible from the _____ and _____.
4. Bus bars and conductors shall be arranged to avoid _____ due to _____ effects.
5. There shall be a _____ foot minimum clearance above a switchboard in a room having a non-fireproof ceiling.
6. Switchboard frames shall be _____.
7. Define a lighting panelboard: _____

   _____

   _____
8. There shall be a maximum of _____ overcurrent devices in a lighting panelboard.
9. Maximum overcurrent protection of a lighting panelboard shall be _____ amperes.
10. Cabinets in wet locations shall be _____.
11. Switches shall be on the _____ side of fuse.
12. Bare bus bars in panelboards shall be _____ mounted.
13. The total continuous load on an overcurrent protective device in a panelboard shall not exceed _____ percent of its rating.
14. Clear work space in front of a panelboard shall be at least _____ inches.
15. The minimum clearance behind a switchboard is _____ feet.
16. What section of the N. E. Code has the rulings on questions 14 and 15 above? _____

17. An equipment grounding terminal bar is required for all panelboards. True/False. _____ Code Reference _____

18. The neutral bar can be used as a terminal for equipment grounding conductors. True/False _____ Code Reference _____

19. Where are the equipment grounding and neutral terminal bars bonded together? _____

NAME _____ LESSON D-13

DATE _____ WORKSHEET

HIGH VOLTAGE EQUIPMENT AND INSTALLATION

1. High voltage equipment and conductors must have _____sufficient for the voltage employed.

2. Where bare connections and buses are used, insulation is provided by _____. The higher the voltage, the greater the _____.

3. What are the five main methods of installing above ground high voltage conductors?

   a. _____

   b. _____

   c. _____

   d. _____

   e. _____

4. What are the three main methods of installing underground high voltage conductors?

   a. _____

   b. _____

   c. _____

5. What is the purpose of shielding a high voltage conductor?

   _____

6. What three types of devices are used to terminate the static voltage shields on high voltage cable?

   a. _____

   b. _____

   c. _____

7. If braid-covered insulated conductors are used for open wiring, they shall have a _____ saturant applied after installation.

8. Is the static voltage shield grounded? Yes/No _____. Give the N. E. Code article for your answer. _____

9. Type MV cables are rated to 35000 volts. True/False code reference. _____

10. Is a special type terminator required for metal-sheathed high voltage cable? Yes/No. _____. If so, what type? _____

_____.

11. What is the major difference in the equipment installed in regular work and that of high voltage equipment? _____

_____

NAME _____ LESSON D-14

DATE _____ WORKSHEET

THEATERS AND ASSEMBLY HALLS

1. What types of public buildings are covered under Article 520?

   a. _____ f. _____

   b. _____ g. _____

   c. _____ h. _____

   d. _____ i. _____

   e. _____ j. _____

2. Wiring shall be installed in metal _____, type _____ cable, or type _____ cable.

3. Maximum conductor fill of raceways shall not exceed _____ percent of the interior cross-section area of the raceway.

4. Maximum conductor fill of a _____ or _____ shall not exceed 20 percent of the interior cross-section area of the _____ or _____. .

5. Stage switchboards shall be the _____ - _____ type.

6. Stage switchboards shall contain _____ protection and _____ for all stage receptacles.

7. Maximum overcurrent protection for a dimmer shall be _____ percent of the dimmer rating.

8. The circuit supply _____ _____ type dimmers shall not exceed 150 volts between conductors.

9. Maximum loading for a footlight circuit shall not exceed _____ amperes.

10. Minimum conductor insulation for border lights shall have temperature rating _____ C. (_____ F.).

11. Supply cables to border lights shall be Types _____, _____, or _____ flexible cord.

12. Minimum rating for arc lamp receptacles shall be _____ amperes; minimum wire size shall be # ____ AWG.

13. Minimum rating for _____ lamp receptacles shall be 20 amperes; minimum wire size shall be # ____ AWG.

14. Plugs for _____ and _____ receptacles shall not be interchangeable.

15. Portable switchboards shall be supplied from _____ _____ outlets.

16. All _____ and _____ _____ in portable switchboards shall be externally-operable, enclosed type.

17. Minimum rating for receptacles in portable plugging box shall be _____ amperes.

18. The female half of the cable connector shall be attached to the _____ end of the cord.

19. Pendant lampholders shall not be installed in _____ rooms.

20. All _____ and _____ in dressing rooms shall be controlled by wall switches.

21. Each _____ controlling receptacles in a dressing room shall be provided with a _____ _____.

NAME _____ LESSON D-15

DATE _____ WORKSHEET

COMMUNICATIONS CIRCUITS

1. What types of communications circuits are covered by Article 800 of the N. E. Code?

   a. _____ d. _____

   b. _____ e. _____

   c. _____

2. Underline correct words to make true statements:

   These systems (are / are not) connected to a central station and they (do / do not) use similar types of equipment, methods of installation and maintenance.

3. An approved protector shall be installed on each _____ or _____ circuit.

4. The _____ shall be located in or on the building near to the point where the _____ enter.

5. The protector shall not be installed in _____ _____.

6. The protector shall be mounted on a non- _____, non- _____ insulating base.

7. The protector shall consist of an _____ in each _____ conductor.

8. An _____ shall be installed between each _____ conductor and the ground.

9. Open conductors shall be separated at least _____ inches from any light or power conductors not in _____ raceways.

10. Communications conductors shall not be installed in the same raceway, _____ box, compartment or _____ box with conductors for light and power circuits.

11. Conductors bunched together in a vertical run in a shaft shall have a _____ - _____ jacket.

12. _____ communications conductors shall be installed _____ the light and power conductors.

13. Conductors shall not be attached to a _____ _____ which carries _____ and _____ conductors.

14. Conductors passing over buildings shall be kept a minimum of _____ feet above any roof.

15. Open conductors on buildings shall be separated at least _____ inches from light or power conductors not in _____ or _____.

16. If the protector is installed inside the building, the conductors shall enter through an insulating _____ or in a _____ raceway.

17. A minimum separation of _____ feet shall be maintained between open communication conductors and lightning conductors.

18. Underground conductors in a manhole shall be installed in a _____ _____ from the light or power conductors.

19. Metal sheath of aerial cables entering a building shall be _____.

20. The minimum protector grounding conductor shall be No. _____ copper.

21. The grounding conductor shall be guarded from _____ _____.

22. The grounding conductor shall be run in a _____ _____ to the grounding electrode.

23. The grounding conductor shall be connected to a _____ _____.

24. The grounding conductor shall be attached to a pipe electrode by a _____ _____.

25. Why should all grounding electrodes be bonded together? _____

_____

_____

Give the N. E. Code Article which allows this. _____

NAME _____ LESSON D-16

DATE _____ WORKSHEET

RADIO AND TELEVISION EQUIPMENT

1. Article 800 shall not apply to equipment for coupling _____ _____ to power line conductors.

2. Radio noise suppressors shall be an _____ _____ for the purpose.

3. Radio noise suppressors shall not be exposed to _____ _____.

4. Lead-in conductors with spans less than 35-feet may be _____ _____ or _____ _____ copper.

5. Outdoor _____ shall be securely supported.

6. Hard _____ copper shall be used for antenna conductors.

7. Lead - _____ conductors shall be securely _____ to the antenna.

8. Outdoor antenna conductors shall not cross over _____ or _____ conductors.

9. Splices and _____ may be made in antenna spans.

10. Antenna masts shall be permanently _____.

11. Minimum size hard-drawn copper conductors permitted for receiving station outdoor antenna shall be No. _____ AWG.

12. Outdoor antennas shall be designed to withstand _____ and _____ loading conditions.

13. Minimum distance between open conductors of a communication system on buildings and lightning system conductors shall be at least _____ feet.

14. In general, the minimum distance between indoor antenna and power conductors shall be _____ inches.

15. Each outdoor lead-in conductor shall be provided with a _____ _____.

16. Lightning arresters shall be located _____ the building.

17. Lightning arresters shall be located near _____- _____ material and shall not be installed in _____ _____.

18. The grounding conductor shall be of _____.

19. The grounding conductor may be _____ or _____.

20. The grounding conductor shall be installed in a _____ _____ between the antenna and grounding electrode.

21. The grounding conductor shall be connected to a _____ _____ underground electrode by means of a _____ _____.

22. Receiving station grounding conductors may be installed _____ or _____ the building.

23. The minimum size receiving station grounding conductor shall be No. _____ AWG (copper).

24. One receiving station grounding conductor may be used for _____ and _____ purposes.

25. The minimum size hard-drawn copper conductor for amateur transmitting systems shall be No. _____ AWG.

26. Minimum building clearance for amateur transmitting antenna conductors shall be _____ inches.

27. Each lead-in conductor for an outdoor amateur transmitting antenna shall be provided with a _____ _____.

28. The minimum size protective ground conductor for amateur transmitting stations shall be No. _____AWG (copper).

29. The minimum size operating grounding conductor for transmitting stations shall be No. _____ (copper).

30. Transmitters shall be enclosed in a _____ frame.

31. All external metallic handles and controls on a transmitter shall be _____.

32. Interlocks shall be provided on all _____ access doors.

33. Remote audio-amplifiers shall be _____ and _____.

NAME _____ LESSON D-17

DATE _____ WORKSHEET

DATA PROCESSING EQUIPMENT

1. Article 645 of the N. E. Code applies to the following items of data processing systems:

   (a) _____
   (b) _____
   (c) _____
   (d) _____
   (e) _____

2. The ampacity of the branch circuit conductors supplying data processing equipment shall be at least _____ percent of the total _____ _____.

3. What are three methods of connecting data processing systems to their power supply?

   (a) _____
   (b) _____
   (c) _____

4. Computer cords and cables may be run on the surface of a floor if _____ from physical _____.

5. Computer cables can be installed under a raised floor. Yes/No _____ Article Reference _____.

6. Branch circuit supply conductors installed under a raised floor feeding receptacle shall be installed in:

   (a) _____
   (b) _____
   (c) _____
   (d) _____
   (e) _____

7. Power and communication supply cables may be installed under a raised floor without any ventilation. Yes/No _____. Give the N. E. Code section for your answer _____.

8. What two systems must be provided with a disconnecting means readily accessible within the data processing room?

   (a) _____
   (b) _____
   _____

9. Data processing equipment grounding shall conform to what Article of the N. E. Code? _____

10. List the three items of information which must be shown on each item of electrical data processing equipment.

(a) _____
(b) _____
(c) _____

NAME _____ LESSON D-18

DATE _____ WORKSHEET

LOW VOLTAGE SYSTEMS

1. Give two examples of low energy power circuits:

   (a) _____
   (b) _____

2. Low energy circuits have the _____ limited and are considered Class _____ remote-control circuits.

3. Low voltage power circuits have the _____ limited and are considered Class _____ remote-control circuits.

4. Safety control circuits are considered as Class _____ remote-control circuits.

5. Wiring methods in general for a Class I remote-control circuit shall conform to Chapter _____ of the N. E. Code.

6. Conductor sizes are usually No. _____ or No. _____ AWG.

7. Multiple signal and/or power remote control circuit conductors can be installed in the same _____ providing all conductors are _____.

8. Why are conductors for low voltage systems more likely to become damaged during installation than regular wires? _____
   _____
   _____.

9. What is the maximum overcurrent protection which can be used for a No. 18 or No. 16 low voltage system conductor? _____ Amps.

10. Where are the overcurrent protective devices for low voltage systems generally located? _____

11. Because of the low voltages involved, are these type circuits and equipment required to be gounded? Yes/No _____. Give the N. E. Code Article for your answer _____.

12. Match the proper voltage with the limiting current for Class II systems.

Column A Voltage	Column B Low Current
_____ (a) Maximum 15 volts	1. One ampere
_____ (b) 15 to 30 volts	2. 5 amperes
_____ (c) 30 to 60 volts	3. 1.6 amperes
_____ (d) 60 to 150 volts	4. 5 milliamperes
_____ (e) Maximum 150 volts	5. 3.2 amperes
	6. 15 amperes

13. Maximum line side protection for a Class II remote-control system transformer is _____ amperes.

14. Outside installation of Class II remote-control system wiring requires lightning protection. Yes/No ____. Give the N. E. Code section for your answer _____.

NAME _____ LESSON D-19

DATE _____ WORKSHEET

ANALYSIS OF CONTROL CIRCUITS

1. A motor circuit should be converted to a _____ _____ in order to analyze it.

2. In an analysis of a control circuit, always consider the circuit _____ _____ at a time.

3. A repairman should always consider every component of a circuit in its _____ and _____ positions.

4. Be systematic in the study of a circuit contact by _____ and coil by _____.

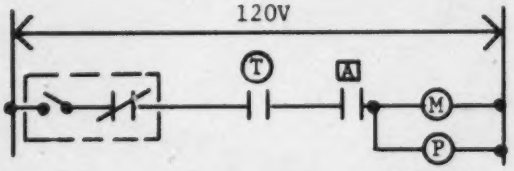
5. Always study a control circuit through its normal sequence from _____ to _____.

6. For the inexperienced workman, what is the greatest danger in circuit analysis? _____

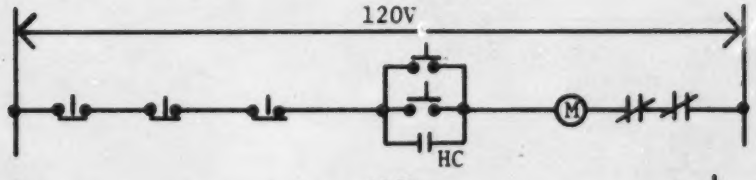
7. A good troubleshooter has the ability to _____ the control circuit and determine quickly which _____ is causing the malfunction of the equipment.

Describe the operation of the following schematic diagrams:

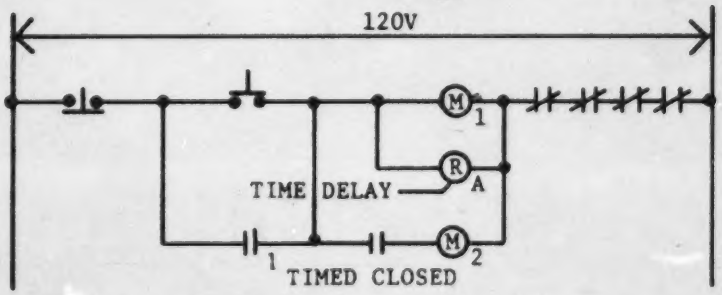
8.



9.



10.



NAME _____ LESSON D-20

DATE _____ WORKSHEET

MAINTAINING CONTROL EQUIPMENT

1. Maintenance means to _____ the equipment in _____.

2. Maintenance is to clean it, _____ it, _____ it, and _____ it frequently.

3. The chief cause of brake failure is worn brake _____ or brake _____.

4. _____ _____ should never be allowed to reach the dangerous condition of wear.

5. Improper _____ adjustment is a frequent cause of coil burn-out on brake solenoids.

6. Plant maintenance men must think _____.

7. Carelessness and _____ to observe _____ precautions are two things that maintenance men cannot afford.

8. List two purposes of a periodic inspection:

   a. _____

   b. _____

9. The greatest causes of control system failures are _____ and _____; _____ and _____.

10. Bearings of _____ and mechanical _____ should be checked for proper lubrication.

11. Short circuits and grounds may be prevented by the proper inspection of insulation and by using a _____ tester.

12. The first law of maintenance is to _____ _____ _____.

13. The second law of maintenance i to be a good _____.

14. Motor starter failure is due frequently to _____ _____.

15. A repairman should never file _____ contacts.

16. Excessive arcing and pitting is caused by improper _____ or lack of contact _____.

17. List two major causes of automatic equipment failure:

    a. _____

    b. _____

18. List two major causes of coil burnouts:

    a. _____

    b. _____

19. Overload relays should be tripped by _____ periodically to check proper operation.

20. Current relays should be checked for proper amount of _____.

21. Time delay relays should be _____ periodically.

22. Pilot devices require very little _____.

23. Limit switches are prone to _____ _____.

NAME _____ LESSON D-21

DATE _____ WORKSHEET

TROUBLESHOOTING CONTROL CIRCUITS

1. Troubleshooting control work requires a _____ person.

2. Troubleshooting of control circuits requires an analytical mind trained in all the aspects of control _____, _____, _____, and circuit _____.

3. Efficient troubleshooting is accomplished by _____ and _____ circuit analysis.

4. Initial checking of all connections in all the wiring is trouble-shooting by _____ and _____.

5. The initial step in troubleshooting is to _____ the _____.

6. The second step is to follow the operation of the _____ through the expected _____ to find the _____ of the circuit that is malfunctioning.

7. Lack of _____ of control functions, control components, control circuits or circuit analysis will cause undue _____ and _____ of time.

8. Remember that the circuit operated originally, and it must have been _____ wired.

9. A good troubleshooter must understand the _____ circuit and the _____ of the machine.

10. We analyze the _____to determine the malfunctioning _____ component causing the circuit failure.

11. The coil should be removed from the circuit to make a _____ check.

12. A high _____ reading on a coil indicates the coil must be replaced.

13. Control circuits are made up basically of _____ and _____.

14. A basic rule in troubleshooting is to _____ only one thing at a time.

15. Do not underestimate the value of the _____ _____ in determining the cause of the trouble.

16. All failures of electric control circuits are not necessarily caused by _____ trouble.

17. A troubleshooter should be equipped with the following testing meters: _____, _____, and an _____.

18. When inspecting a magnetic starter, check the _____ _____ for tripping.

19. Always check the _____ feeding the coils of a relay.

20. The repairman should change only the _____ _____ that is causing the circuit to malfunction.

NAME _____ LESSON D-22

DATE _____ WORKSHEET

PRINCIPLES OF STATIC CONTROL

1. A system of machine control which utilizes no _____ parts or _____ contacts is defined as static control.

2. The life of a control system is increased by the use of _____ _____ devices.

3. Static control and its circuit requirements are expressed in terms of _____ functions.

4. List five elements of logic functions:

   a. _____

   b. _____

   c. _____

   d. _____

   e. _____

5. The subject of "static control" can be broken down into three parts:

   a. _____

   b. _____

   c. _____

6. A static control device that will provide an output after a lapse of time when it received one or more inputs is called a _____ _____ element.

7. A conventional control circuit expressed in different terms is similar to a _____ _____.

8. The oldest method of static control uses _____ _____.

9. The most reliable static control uses _____ amplifiers in conjunction with rectifiers, _____ and _____ _____.

10. The "Information Section" of a machine is called _____ _____.

11. The "Decision Section" _____ and _____ the information.

12. The "Action Section" operates an _____ to produce the desired results.

13. Until automation arrived, the "Decision Section" was made with _____.

14. Logic devices may have one or more _____ and a single _____.

15. The output of a magnetic amplifier is less than _____ watt.

16. Each _____ of a static control system uses its own ideas.

17. Draw the symbols for each of the five elements of logic functions and the amplifier.

a. d.

b. e.

c. f.

NAME _____ LESSON D-23

DATE _____ WORKSHEET

TRANSISTORS AS LOGIC ELEMENTS

1. What are the three sections of a transistor?

   a. _____

   b. _____

   c. _____

2. Draw a symbol of: a. PNP b. NPN

3. What is the purpose of a heat sink in a power transistor? _____

   _____

4. The middle letter of the transistor indicates the _____ polarity.

5. What are three advantages of the transistor over the vacuum tube?

   a. _____

   b. _____

   c. _____

6. What are holes? _____

   _____

   In which type of transistors are holes the majority current carriers?

   _____ Why? _____

   _____

   _____

7. What portion of a zener-diode characteristic is most useful for voltage regulator application? _____
   Why? _____

8. Will a semiconductor diode permit current to flow when it is (a) forward-biased or (b)reversed-biased? _____

9. How would you identify the anode of an unmarked diode? _____

10. What is a logic circuit? _____

11. Identify the two states of a logic circuit.

    a. _____

    b. _____

BASIC THEORY OF ELECTRONICS

1. The electrician thinks of current in terms of amperes and considers one or two amperes as a very low current. In electronics, we deal with current in milliamperes, and consider one or two amperes to be a very high current.

2. The electrician considers A-C voltage at the consumer location as 110, 220, or 440 volts. In electronics, voltage is generally D-C and often ranges from 300 to 1,000 volts. In this study, we will learn to deal with composite voltages, there will be voltages made up of both D-C and A-C components.

3. We think of power being measured in watts or kilowatts. In electronics, most power requirements are very small, such as milliwatts (1/1000).

The three statements above do not change the basic laws of electricity, but require us to apply the things we know to new situations. Other than the semi-conductor field of electronics, there are only six components commonly used. All six of these components have been studied and now you must apply their use to vacuum tubes.

SWITCHES:

Mechanical devices for completing, interrupting, or changing the connections in an electric circuit.

CIRCUIT:

The electrician works with many types of circuits or paths over which an electric current flows, such as lighting, motor control, etc. There are unlimited variations of the lighting circuit, and there are unlimited variations of the electronic circuits, such as the amplifier circuits. The student that masters the basic circuit will have no real problem with the variations.

COILS:

You are familiar with coils used in motor starters. There is no difference in those coils and the coils used in electronics, except the physical design.

RESISTORS:

A resistor has a power-handling rating from one hundred to several thousand watts. The demands of the circuit in which they are used determines the size. Electronic resistors are specified in ohms or megohms or 1/2 watt or less to 100 watts. The demands of the circuit will determine the size and resistance requirements.

CAPACITORS:

In studying motors, you found that capacitors were used in starting motors and for power factor correction.

Electronic capacitors in radio circuits are used to block the flow of direct current while allowing alternating and pulsating currents to pass. They are rated in microfarads and micro-microfarads.

TRANSFORMERS:

We think of a transformer as a device that transfers electrical energy by electromagnetic induction from one or more circuits to one or more other circuits. It is measured in high voltage and reduces this voltage to usable voltage.

The transformers used in electronics are generally built for specific jobs handling low power at radio frequency. The principles of the large transformer apply to the radio and other electronic devices.

Now, let us consider the new component introduced in this lesson, the vacuum tube. This device involves some new concepts of electricity which you must learn. In use, it acts like either a variable resistor or a switch, or both, depending upon the circuit in which it is used. The main advantage of the vacuum tube is the speed with which it can vary its resistance and turn on or off in response to external signals.

You have learned the theory of electron flow in metallic conductors used in electrical work. It was the flow of free electrons from a negative potential to a positive potential through a conductor that contains free electrons.

Now, let us consider the flow of free electrons through a vacuum or gas. The electron flow is caused by the attraction of unlike charges and the repulsion of like charges. Remember that the flow of current in a vacuum is very small as compared to the flow through a metallic conductor under the same potential. When the proper gas is added to a tube the current flow is increased by a process known as ionization. This will create completely different characteristics for specified uses.

The semi-conductors offer some new concepts in electricity which we must accept and apply in order to understand their use. Semi-conductors are a class of solid materials with high resistance qualities. Another group, more important in communications, are semimetallic elements or oxides in which conductivity is electronic. Semi-conductors are used as rectifiers, detectors, and amplifiers in transistors and thermoelectric elements.

The apprentice will contact industrial electronics on the job in the form of controls and instrumentation. The equipment used in this field will consist of a power supply, an amplifier, and some form of sensing device, and an output device. In working with these devices, it will be difficult to distinguish between electricity and electronics.

NAME _____ LESSON D-24

DATE _____ WORKSHEET

BASIC THEORY OF ELECTRONICS

1. Draw symbols for the following components:

   a. Resistor

   b. Battery

   c. N O Relay Contact

   d. Capacitor

   e. Potentiometer

2. Three basic parts of an electron tube are:

   a. _____

   b. _____

   c. _____

3. List seven principal functions performed by electron tubes.

   a. _____ e. _____

   b. _____ f. _____

   c. _____ g. _____

   d. _____

4. Will a vacuum tube diode permit current to flow in both directions? _____ Explain. _____

5. What is meant by the μ of a triode? _____

6. How does a positive limiter differ from a negative limiter?
_____
_____
_____
_____

7. How does a series limiter differ from a parallel limiter?
_____
_____
_____

8. What is the purpose of a voltage doubler in reference to rectification? _____
_____

9. Why must a device using a power transformer never be plugged into direct current? _____
_____
_____

10. In a transformer power supply, what is the purpose of a choke input filter? _____

11. What is meant by rectification? _____
_____

12. Describe the nature of the output voltage of (a) Half-wave rectifier : _____
_____(b) Full-wave rectifier: _____
_____

13. Is it possible for a tube or CRT to check "good" on a tester and yet be inoperative in a circuit? _____ Explain. _____
_____
_____
_____
_____

NAME _____ LESSON D-25

DATE _____ WORKSHEET

WELDERS, RESISTORS & RECTIFIERS

1. _____ welding and _____ welding are the two general types of electric welding.

2. In _____ welding, an _____ is drawn between the metal parts to be joined together and a metal electrode, and metal from the electrode is deposited on the joint.

3. In _____ welding, the metal parts to be joined are passed tightly together between two electrodes, and a _____ _____ is passed through the electrodes and the metal parts to be welded.

4. The maximum overcurrent protection for an electric arc welder is _____ percent of the rated _____ current.

5. A _____ _____ shall be provided in the supply line to each welder.

6. The minimum capacity of a supply conductor to a varying operation type manual-operated resistance welder shall be _____ percent of the rated _____ current, _____ percent for automatic resistance welders.

7. Maximum overcurrent protection for supply conductors to an arc welder shall be _____ percent of _____ rating.

8. The maximum overcurrent protection for a resistance welder shall be _____ percent of the rated _____ current.

9. The maximum overcurrent protection for supply conductors to a resistance welder shall be _____ percent of _____ rating.

10. Insulated conductors used for resistor connections shall have a rating of not less than _____ °C (_____ °F).

11. Give five reasons why silicon rectifiers are replacing other types of power conversion apparatus:

    a. _____ d. _____

    b. _____ e. _____

    c. _____

12. Name three other methods of power conversion apparatus:

    a. _____

    b. _____

    c. _____

13. Selenium rectifiers have the unusual ability to _____ or _____ ruptures caused by overvoltages within their ratings.

14. Sometimes a selenium rectifier is used as _____ protection for _____ rectifier cells.

INFORMATION SHEET LESSON D-26

JOB MANAGEMENT

DISCUSSION OUTLINE:

1. What you manage
   a. Yourself
   b. Your helper
   c. Tools and equipment
   d. Time and material

2. How you manage--"Bull-of-the-woods," phasing out--replaced by
   a. Leader
   b. Instructor
   c. Paper-work man

3. Why you manage
   a. Every job must have some management
   b. Increase efficiency
   c. Lower costs
   d. Improve profit margin

4. When you manage
   a. Before job starts
   b. During job
   c. After completion of job
   d. "Off duty" hours--planning and layout

5. Where you manage
   a. On the job
   b. Personal life
   c. Community life

FOLLOW THESE TWELVE RULES IF YOU'RE PROMOTED TO A MANAGEMENT JOB

(A. J. Drucker, Manager of the Management Development Center in IBM's Data Processing Division suggests:)

1. Don't get personally involved when something doesn't seem to be turning out right. (Help your subordinates find a solution.)

2. Talk less and listen more.

3. Make sure your door is open to your associates. You can't learn everything from written reports.

4. Remember that what motivated you may not motivate your subordinates. (Find out what makes each man tick and apply it accordingly.)

5. Set out to help your men develop their greatest potential. (You also will be judged on how well you perform this job.)

6. Adopt a positive attitude in performing the administrative detail your job requires. (How well you handle it will figure importantly in any estimate of your future potential.)

7. Don't shy away from decisions in the early months. Your judgments must have been good so far or you wouldn't have been promoted. (So don't be afraid of making them.)

8. Think management. You are the company; its policies are your policies. (So don't apologize for any headquarters action. If you do, you will weaken your authority.)

9. Don't always support the old and familiar. (Give a fair hearing to new ideas.)

10. Gradually moderate your former close relationships with subordinates.

11. Don't tolerate mediocrity. (Your subordinates want to meet a high standard.)

12. Work harder than ever.

MANAGEMENT SHOULD ELIMINATE COMPLAINTS ABOUT CONFERENCES

According to research on business meetings conducted by a manufacturer, the corporate officer or supervisor errs in one or more of three ways:

1. He calls a meeting without any real reason. The subject could have just as easily been resolved by a telephone call.

2. He calls a meeting at the drop of a hat. (Nobody has a chance to prepare, gather facts, or do any advanced thinking and nothing is achieved.)

3. He may not conduct the meeting well; it gets underway late, is interrupted by telephone calls and secretaries, and discussions become untracked resulting in no decisions.

You'll do better following these simple tips:

1. Never call a meeting if you can write or phone - or either delegate the job or do it yourself.

2. Invite only those persons who are directly concerned with the matter at hand.

3. Always tell them ahead of time what topics will be covered and give them time to prepare.

4. Start on time, end on time, and don't permit any interruptions.

SUPPLEMENTARY REFERENCES

"Here's How" Booklets: (Available from the Bureau of National Affairs, Incorporated, 1231 24th Street, N.W., Washington, D. C., 20037. The cost of each booklet is 25¢.)

How to Be a Leader, A 10-point program to develop and demonstrate leadership.

How to Get Teamwork, Ten steps to high employee morale and a strong team spirit.

How to Correct Misunderstandings About Management, How to get facts across to employees, scotch gossip, rumor, and hearsay.

EFFECTIVE FOREMANSHIP

DISCUSSION OUTLINE:

1. Where foremen come from

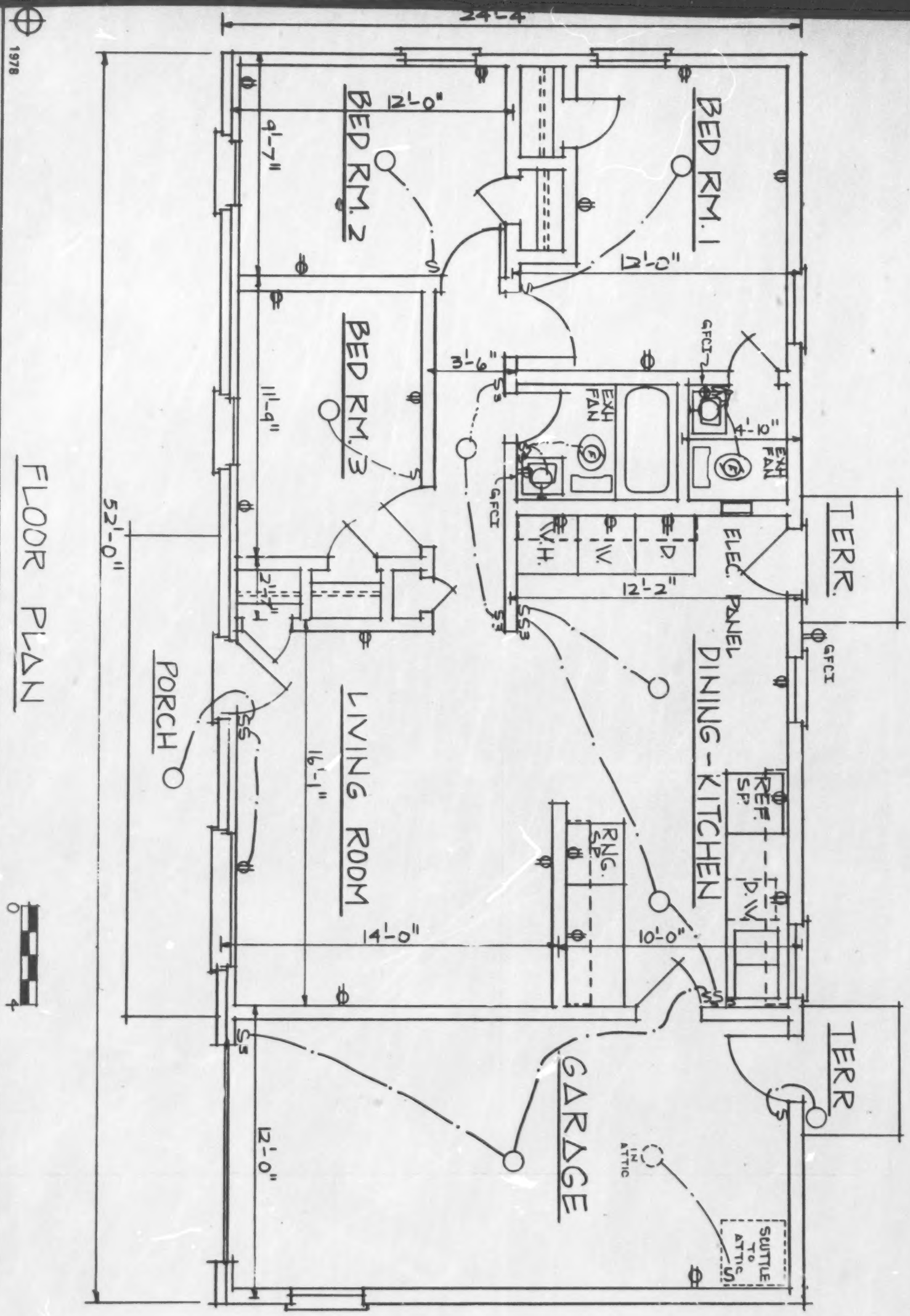
2. Why are they selected
   a. Leadership qualities
   b. Organizational ability
   c. Mechanical skill
   d. Technical skill
   e. Judgment
   f. Initiative
   g. Education
   h. Character
   i. Human interest
   j. Physical and mental ability

3. Foreman's training
   a. Starts at childhood
   b. Develops as he grows
   c. Improves as he progresses
   d. Always something new to learn
   e. No "guaranteed course" with all the answers

4. Half of the job almost done
   a. Apprentice training
      (1) On-the-job
      (2) Related technical training
   b. Your education in general
   c. Your life's experiences
   d. Your association with other people

5. The other half of the job
   a. Skills of leadership
   b. Methods of personnel supervision
   c. Development of sound administrative procedures
   d. Improving on-the-job performance

FLOOR PLAN



GUILFORD TECHNICAL INSTITUTE, JAMESTOWN N.C.	FLOOR PLAN	STUDENT: GARY ROBBINS STUDENT NO. 6248 326 PINEVIEW ST ASHEBORO, N. C.
ARCHITECTURAL TECHNOLOGY DEPARTMENT		SHEET NO. 1 OF 1.